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**Cover:** *The carabid beetle genus Nurus has about 10 large, heavy-bodied species which occur along the eastern seaboard of Australia from northern NSW to north Qld. They live in spiral burrows which they excavate with their mandibles. Prey is ambushed from the burrow entrance at night. Females brood their eggs and first instar larvae in the burrow. Nurus brevis Motschulsky, 1865 occurs near Lismore and is listed as rare and endangered by NSW legislation. Illustration by Geoff Thompson.*

# THRIPS AND THEIR HOST PLANTS: NEW AUSTRALIAN RECORDS (THYSANOPTERA: TEREBRANTIA)

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## Abstract

This list updates the 1996 ABRS Zoological Catalogue, with 7 genera and 14 species of Terebrantia not recorded previously from continental Australia, together with a further 18 species recorded from Australia since publication of that catalogue, newly established larval host plant relationships for a further 12 species and range extensions for some others.

## Introduction

The information presented here emphasises two problems in our understanding of the Australian insect fauna. The northern tropical zone of this continent either shares a considerable thrips fauna with territories to the north, or is currently susceptible to extensive invasions from those territories; we cannot know which, given the present lack of base-line data. Moreover, our understanding of the Australian fauna has been outstripped by taxonomic descriptive activity. Collecting and describing new taxa is easy; understanding the position of those taxa in ecosystems and thus how they interact in the maintenance of biological diversity is both more difficult and more important. The purpose of the following notes is to record 14 named species that have previously not been recorded from Australia (indicated *), to list a further 18 species (indicated #) that are not given in the ABRS Zoological Catalogue (Mound 1996a) but have been recorded in various subsequent publications, to record newly recognised host-plants for a further 12 species and to note some nomenclatural changes and range extensions. An electronic listing, revised to December 2000, is available at http://www.environment.gov.au/abrs/abif-fauna/chcklist.htm

In recording a total of 170 species of Thysanoptera Terebrantia from Australia, in 61 genera and three families, Mound (1996a) stated that the fauna seemed to be poorly known, the list being dominated by introduced taxa. Most of the native species were known only from single samples, even single damaged specimens, so that no information was available on host-plant relationships or distribution patterns. During the last five years, an extensive research programme on the Thysanoptera Tubulifera associated with *Acacia* phyllodes (Mound and Morris 2001) has resulted in the largely fortuitous accumulation of much information on species of Thysanoptera Terebrantia. Many new species have been discovered, but no attempt is made here to describe any of these, nor even to list unrecorded genera for which the only species found in Australia remain undescribed. The endemic thrips fauna is certainly more diverse than published records indicate. However, 12 of the 14 species newly recorded here are known also from tropical Asia, thus emphasising the southeast Asian component of the Australian fauna.

The following abbreviations have been used: ACT - Australian Capital Territory; ANIC - Australian National Insect Collection, CSIRO, Canberra; NSW - New South Wales; NT - Northern Territory; OAI - Orange Agricultural Institute collection, Orange; QDPI - Queensland Department of Primary Industries collection, Indooroopilly; Qld - Queensland; SA - South Australia; Tas - Tasmania; Vic - Victoria; WA - Western Australia.

**Merothripidae**

Species in this family are presumed to be fungus-feeding. Three genera are known worldwide, but the only previous Australian records of the family involved three species of *Merothrips* Hood.

**Erotidothrips mirabilis* Priesner. A single female of this species was recognised by John Donaldson, collected in December 1998 at Cairns (Qld) [in QDPI]. It has been taken widely in tropical countries but is known from very few specimens.

**Melanthripidae**

Considered for many years as a synonym of the Aeolothripidae, this family is currently used to include four genera worldwide (Moritz, Mound and Morris 2001). Two of these genera exhibit classical southern hemisphere distribution patterns. *Dorythrips* Hood is found in South America and Western Australia; *Cranothrips* Bagnall occurs in South Africa and Australia. Females of all species in these genera retain the plesiomorphic condition of the seventh abdominal sternite, with a pair of lobes on the posterior margin that represent the ancestral eighth sternite. All of the species in this family apparently feed on and breed in flowers.

*Cranothrips symoni* Mound. This species is known only from the flowers of *Brunonia australis* (Apiaceae), a blue-flowered herb that used to be classified in its own monobasic family. Populations have been found on this plant at three widely separated sites, the Simpson Desert (SA), the Hamersley Range (WA) and, during December 2000, at Mendooran in eastern NSW.

**Aeolothripidae**

Most of the species that are placed in this family are predatory, or at least are facultative predators on other small arthropods in flowers. One species listed here is exceptional in being purely phytophagous.

#*Cycadothrips albrechti* Mound & Terry. This is the third species described in this genus, all breeding only in the male cones of *Macrozamia* (Zamiaceae). *C. albrechti* produces enormous populations in the cones of *M. macdonnellii* in Central Australia. It acts as the pollinator of this plant species and pupates beneath in the soil (Mound and Terry 2001).

#*Mymarothrips bicolor* Strassen. Mound and Marullo (1998) pointed out that the record of the Oriental species *M. garuda* Ramakrishna & Margabandhu

from Darwin (NT) by Mound (1996a), was based on a misidentification of *M. bicolor*, described from Krakatau, Indonesia. These thrips are predatory on the larvae of other thrips species on the leaves of trees.

**Thripidae**

Two subfamilies are recognised in this family. The first includes the species related to the greenhouse thrips (Mound, Marullo and Trueman 2001) The second includes most of the thrips species that are major pests, including all the tospovirus vectors (Mound 1996b).

*Panchaetothripinae*

All species in the subfamily appear to be leaf-feeding and are commonly associated with older leaves rather than young leaves. Polyphagy seems to be common in this group, with few of the species known to exhibit particular host associations. Mound (1996a) listed 17 species in 13 genera from Australia in this subfamily; three further genera and species are here recorded from the Australian mainland for the first time.

*Anisopilothrips venustulus* (Priesner). Widespread, particularly on tropical islands (Mound and Marullo 1996), this species was recorded from Australia on a single female taken in rainforest near Taree (NSW). A second female has been taken recently at the same site and a further female collected near Cape Tribulation in northern Qld.

**Astrothrips tumiceps* Karny. Described from Java and recorded from Pakistan, India, Malaya and the Philippines, Glenn Bellis collected a series of females in August 1999 at Old Arafura, 450 km east of Darwin (NT), that were causing leaf scorching on *Annona muricata* (Annonaceae).

#*Australothrips aliceae* Marullo and Mound. This Northern Territory species appears to be associated only with turkey bush, *Calytrix brownii* (Myrtaceae) (Marullo and Mound 1997). In contrast, the only other member of the genus, *Australothrips bicolor* Bagnall, is widespread across Australia on the leaves of various Myrtaceae, including species of *Eucalyptus*.

**Copidothrips octarticulatus* (Schmutz). Described from Sri Lanka, with synonyms from Taiwan and Kiribati, Mound (1996a) recorded this species from the Australian territory of Christmas Island, under the name *C. formosus* Hood. It has been seen from Pohnpei (Micronesia) damaging kava (*Piper methysticum*) and from Seychelles on crucifer seedlings. At Berrimah Farm, Darwin (NT), it was found in April 1999 causing leaf damage to *Aglaonema* (Araceae), this being the first record from the Australian zoogeographical region.

**Elixothrips brevisetis* (Bagnall). Described from Sri Lanka and subsequently recorded from territories between Taiwan and various Pacific islands, specimens have been studied from Cape Tribulation (Qld). Others are listed [in OAI] from Mt Edith and Mt Spec in northeastern Qld.

*Moundothrips apterygus* Wilson. This unusual wingless panchaetothripine was described on specimens stated to have been collected from "grasses" at Meningie near the Coorong (SA). However, a visit to the type locality in December 2000 revealed that the "grass" on which this thrips lives is actually a grass-like rush, *Apodasmia brownii* (Restionaceae).

*Retithrips javanicus* Karny. Described from Java and recorded from Singapore and the Philippines (Reyes 1994), the only Australian record of this species was based on four females collected in the McArthur River area (NT). However, in May 1999 Tony Postle collected one female from *Lagerstroemia* (Myrtaceae) at Broome (WA).

*Thripinae*

Mound (1996a) listed 124 species in 35 genera from Australia in this subfamily. These species exhibit a wide range of biologies. In some genera, species are associated with the flowers of particular groups of plants, *e.g. Odontothripiella* Bagnall on Fabaceae flowers, *Dichromothrips* Priesner on Orchidaceae and several genera on Poaceae. In other genera, such as *Pseudanaphothrips* Karny, species are associated with flowers of host plants that are only distantly related and, in some genera including *Anascirtothrips* Bhatti, *Dendrothrips* Uzel and *Parabaliothrips* Priesner, the species live only on leaves.

#*Anascirtothrips arafura* Mound & Wang. Described from the leaves of *Ficus* (Moraceae) trees on Melville and Bathurst Islands (NT), this is the third member of this genus. Mound and Wang (2000) provided a key to distinguish the three species and also recorded the following species from Australia for the first time.

#*Anascirtothrips arorai* Bhatti. Described from the leaves of *Ficus* in India and subsequently found on the leaves of *Ficus microcarpa* in Florida, this species was recorded from Australia on specimens collected from *Ficus* on the University Campus at Darwin (NT), in June 2000.

*Apterothrips apteris* (Daniel). This widespread wingless species is commonly associated with grasses, but has been recorded as a pest of lucerne. However, in coastal California it is associated with the leaves of *Erigeron* (Asteraceae). During 2000 it was found by Margaret Williams damaging a crop of garlic near Hobart (Tas), a host association not previously recorded.

**Arorathrips spiniceps* (Hood). Like other members of this genus and also of the closely related genus *Chirothrips* Haliday, this species feeds and pupates within the florets of grasses and is thus easily transported around the world in grass seeds. Mound and Marullo (1996) record it from several Caribbean countries as well as from the following territories in the Pacific: Hawaii, Solomon Islands and Papua New Guinea. There are females in QDPI and ANIC from Bowen in northeastern Qld.

**Chaetanaphothrips leeuwenii* Karny. Presumably originally from SE Asia, in common with the other members of this genus, this species has been recorded widely around the tropics. In the West Indies it has been found in association with banana crops. The new Australian record is based on two females taken in May 1999 on the Cobourg Peninisula, near Darwin (NT).

#*Dendrothrips diaspora* Mound. Although this species has been taken at various sites across Australia, in WA, Qld and NSW, the plant species on whose leaves it breeds remains undiscovered. Mound (1999) provided a key to distinguish the three members of this genus known from Australia.

#*Dendrothrips glynn* Mound. Based on three females collected at Cairns (Qld), this species is very similar to one from New Caledonia.

#*Dendrothrips howei* Mound. Described from Lord Howe Island from five specimens (Mound 1999), this species was found breeding, in December 2001, on the young leaves of *Xylosma maidenii* (Flacourtiaceae).

*Dichromothrips australiae* Mound. Previously known only from the type series collected at Kanangra Walls (NSW), this thrips has now been found on the flowers of *Pterostylis atrans* (Orchidaceae) at Mt Franklin (ACT).

**Dichromothrips corbetti* (Priesner). This SE Asian orchid pest has been taken several times at Darwin (NT), causing damage to the flowers of *Vanda* (Orchidaceae). The dark forewings are pale at the base and the tergites have characteristic sculpture laterally, consisting of a series of transverse parallel lines.

*Dichromothrips spiranthidis* (Bagnall). Described originally on a single specimen from Healesville (Vic), this thrips apparently breeds in the flowers of a range of Orchidaceae. It was collected recently from *Spiranthes sinensis* at Gloucester Tops (NSW) and also near Brisbane (Qld). At Namadgi NP (ACT) it was collected from *Prasophyllum wilkinsoniorum*.

#*Edissa steinerae* Mound. Described on a single female from grasses at Atherton (Qld), this species was also recorded from Thailand and Japan (Mound 1999). The only other member of the genus is from South Africa and Sudan.

*Ensiferothrips primus* Bianchi. Described from New Caledonia, the previously unknown host plant in that country was established by Bournier and Mound (2000) as *Malaisia scandens* (Moraceae). Substantial populations of this thrips were found recently by Geoff Williams, on the under surface of the leaves of this climber near Taree (NSW).

#*Ensiferothrips secundus* Mound. Described from Lord Howe Island, on one female and four males taken on *Smilax australis* (Smilacaceae), this species differs from the only other member of the genus in lacking greatly enlarged setae on the forewing (Mound 1999).

*Hydatothrips argenticinctus* Girault. Described on a single specimen, this species has now been collected widely in eastern NSW, breeding on the leaves of the creeper *Parsonsia straminea* (Apocynaceae).

*Hydatothrips haschemi* Girault. Described from a single female collected on a window, this species appears to be associated with the leaves of various Fabaceae, including *Centrosema* and *Calopogonium*, on which it has been collected around Darwin and also at Kakadu and Larrimah (NT).

**Karphothrips dugdalei* Mound & Walker. Described on a single female from near Auckland, New Zealand, this species is widespread in Australia on the youngest leaves of species of sword grass, *Gahnia* (Cyperaceae). Specimens have been studied from near Albany (WA), near Hobart (Tas), Chichester Dam (NSW) and Monga Forest (NSW). It is a long, slender, yellow thrips, superficially similar to the common grass-living *Aptinothrips* Haliday, but with wings.

*#Leucothrips nigripennis* Reuter. Associated with various cultivated ferns, such as *Pteris cretica*, in various parts of the world, this minute white species with black wings was recorded by Mound (1999) from both Gosford (NSW) and Perth (WA). The other described species in this thripid genus are all from the New World. *L. nigripennis* is probably South American in origin, Brazil being the only country from which it has been recorded outside of cultivation.

**Megalurothrips typicus* Bagnall. Described from Sarawak and recorded from various SE Asian territories including Java, Sumatra and Taiwan, this species differs from the only other member of the genus known from Australia, *M. usitatus* Bagnall, in having the median pair of setae on the seventh sternite arising on the posterior margin, not anterior to this margin (Palmer 1987). The species presumably breeds in flowers of Fabaceae, but Angus Wilson collected several females in the flowers of mango trees at Kununurra (WA), in September 2001.

**Monothrips flavus* Moulton. The only species in this genus is based on a single damaged female, collected from *Saccharum* in Rabaul, New Britain, during 1929. The genus has not been recognisable from its description (Moulton 1940), but one female collected from grasses at Humpty Doo (NT), in May 1999, has now been compared with the holotype on loan from the Bishop Museum, Hawaii and is considered conspecific. The pronotum bears numerous transverse striae, tergites II-VIII each have two or three rows of ctenidia-like microtrichia anterolaterally and a very broad, finely toothed, craspedum on the posterior margin. The sternites have about eight discal setae and a series of stout triangular teeth on the posterior margin laterally. Superficially this thrips looks like a member of the genus *Rhamphothrips* Karny, particularly in the shape of the head and pronotum. However, the chaetotaxy of the seventh sternite is very different from members of that genus (Moritz, Mound and Morris 2001), the median pair of marginal setae

being widely separated and the other two pairs of marginal setae arising near the lateral corners of this sternite.

**Neohydatothrips gracilipes* (Hood). Previously known from the Caribbean area, living on various malvaceous weeds including species of *Sida* (Mound and Marullo 1996), this species has been studied recently from India and Thailand. In northern Australia it has been collected widely on malvaceous weeds between Brisbane (Qld) and Darwin (NT).

*Neohydatothrips diana* (Girault). Described on a female from Mt Coot-tha, Brisbane, this species has been found breeding on the leaves of *Pultenaea procumbens* and *Dillwynia sieberi* (Fabaceae) around Googong Dam (NSW) near Canberra.

*Neohydatothrips haydni* (Girault). Previously known only from one of Girault's most damaged specimens, this species appears to be associated with *Swainsonia galegifolia* (Fabaceae), judging from specimens in QDPI. A very similar, if not identical, species was common in Spring 2001 on *Indigofera australis* (Fabaceae) in the coastal forests inland from Batemans Bay (NSW).

#*Neohydatothrips samayunkur* Kudo. This species was recorded from Australia under the name of a Mexican species, *N. pseudoannulipes* Johansen (Mound, Goodwin and Steiner 1996). However, the available material from Mexico on which this identification was based (Mound and Marullo 1996) subsequently proved to represent two species (Nakahara 1999). It is the second of these two, now recognised as *N. samayunkur* described from Japan, that is the widespread pest of marigold plants and other members of the genus *Tagetes* (Asteraceae). During 1995 this species caused severe damage to cultivated marigolds at Gosford (NSW).

#*Organothrips indicus* Bhatti. This species, the only fully aquatic thrips, was found at Indooroopilly (Qld) breeding on water hyacinth, *Eichhornia crassipes* (Pontederiaceae). Described originally from India on *Typha* (Typhaceae), it has been recorded widely around the world on other aquatic plants (Mound 2000). The males are wingless, almost larviform and particularly difficult to find amongst the surface mucous of their host plant, beneath water level.

#*Organothrips wrighti* Mound. Described on a male and a female taken on Melville Island (NT) and two females from near Cape Tribulation (Qld), another female has now been studied that was collected near Cairns (Qld) [in QDPI]. Presumably the species is widespread on grasses or rushes growing near water across northern Australia (Mound 2000).

*Parabaliothrips setifer* (Karny). Until recently this species has been known only from the type specimen that was collected early in the last century. It has now been found breeding on *Leucopogon lanceolata* (Epacridaceae) at Monga Forest (NSW) and at Walcha (NSW). A further new species of this

genus is currently being described (Gillespie, Mound and Wang 2002), living on the buds of *Ficus macrophylla* (Moraceae) at Sydney (NSW).

*Pseudanaphothrips araucariae* Mound & Palmer. Described from the male cones of *Araucaria bidwilli* in southern Queensland, this Australian thrips also produces large populations in Queensland in the male cones of at least two species of *Pinus* (Pinaceae). These populations have become so large around Cardwell (northern Qld) that the thrips has become a serious nuisance annually, entering a local school in vast numbers (Mound, Ritchie and King 2002).

*Pseudanaphothrips frankstoni* (Steele). Previously known only from two females collected in the flowers of blackberries in Victoria, large populations have been found amongst the sori on fronds of the tree fern *Dicksonia antarctica* (Dicksoniaceae) in narrow gullies at Tidbinbilla (ACT).

*Pseudodendrothrips darci* (Girault). Described from a single female taken at Indooroopilly (Qld), this minute pale species is probably widespread on *Ficus* leaves. In providing a key to the three members of *Pseudodendrothrips* Schmutz from Australia, Mound (1999) indicated that *P. darci* cannot be distinguished at present from the common SE Asian species *P. bhattii* Kudo.

#*Pseudodendrothrips gillespei* Mound. This large dark member of the genus was described from Lord Howe Island on the leaves of *Alyxia ruscifolia* (Apocynaceae). It has recently been recorded from mainland Australia, one female being collected by Geoff Williams near Taree (NSW).

#*Pseudodendrothrips mori* (Niwa). Three females of this pest of mulberry trees were found on a sandpaper fig near Cooktown, northern Qld (Mound 1999). The species has been reported widely around the world, but there is no other Australian record.

**Rhamphothrips pandens* Sakimura. Recorded widely from the Caribbean and across the Pacific to Java, but always in low numbers without good evidence of a specific host relationship, a single female of this species was taken on the Cobourg Peninsula (NT) in May 1999.

#*Salpingothrips aimotofus* Kudo. One female and one larva of this species were collected at Indooroopilly (Qld), but it probably occurs widely across the northern parts of Australia. In China and Taiwan the species is associated with the leaves of the Fabaceae vine, kudzu (*Pueraria*).

*Scirtothrips albomaculatus* Bianchi. Described from New Caledonia, this species has been taken widely in eastern Australia. Adults have been taken on many different plants, but the species is probably associated with the widespread and variable shrub *Dodonaea viscosa* (Sapindaceae).

*Stenchaetothrips biformis* (Bagnall). Very few specimens of the oriental rice thrips have been collected in Australia and none from rice crops. However,

the species seems to be well established near Brisbane at Indooroopilly (Qld), judging from a long series of both sexes [in QDPI] taken from reeds along the roadside near the Long Pocket Laboratories.

**Thrips extensicornis* Priesner. Described from Java and recorded from Taiwan and the Philippines, this flower-living species was taken in considerable numbers at Berrimah Farm, Darwin (NT), damaging flowers of *Gardenia* (Rubiaceae) during October 1999. Unlike related species in this large genus, females have only a single pair of discal setae on each abdominal sternite. There is also a series of this species in QDPI, collected at Cairns (Qld) on *Pavetta indica* (Rubiaceae), during November 1985.

*Thrips knoxi* (Girault). Known previously from one female, this is a common, apparently univoltine species breeding in spring in the flowers of a range of small species of the genus *Lomandra* (Xanthorrhoeaceae). It is less common in the flowers of *L. longifolia* and its cultivars, in which the common eastern flower thrips, *Thrips setipennis* (Bagnall), is frequently abundant. *T. knoxi* is widespread along the east and south coasts from at least Brisbane (Qld) to Adelaide (SA). It is an unusual member of the genus, with a small glandular area on the third sternite in females and a broad-based sensorium on the sixth antennal segment. The number of antennal segments varies between seven and eight.

*Thrips nigropilosus* Uzel. Records of this minor pest are rare in Australia, but a substantial population was observed by Marilyn Steiner on the leaves of a garden *Achillea* (Asteraceae), at Gosford (NSW), for some months in 1998.

**Thrips novocaledonensis* (Bianchi). This is the dominant member of the genus in a range of flowers in New Caledonia (Bournier and Mound 2000). It is established on Norfolk Island, where it has been found in large numbers in the flowers of *Lantana* and from whence it has been taken in quarantine at Sydney (NSW).

*Thrips palmi* Karny. This SE Asian species was first collected in Australia at Darwin (NT) in June 1989, then again at Ormiston, Brisbane (Qld) in July 1990 (Houston *et al.* 1991). Since then, John Donaldson has identified the species from various crops at different sites on the Atherton Tableland (Qld), including lettuce, navy bean, capsicum, pumpkin and eggplant. The presence of this species and its dispersal within Australia are usually considered to be due to transmission by the horticultural trade. It is found regularly in quarantine on imported cut flowers such as orchids and translocation internally by the trade in vegetable seedlings is easy. In September 2001, John Moulden collected *T. palmi* at Kununurra (WA) from damaged seedlings of *Lisianthus*. Although inter-state horticultural trade may have caused this, the possibility cannot be discounted that this species is now part of the natural thrips fauna of northern Australia, with populations supplemented by winds from Indonesia.

*Thrips parvispinus* (Karny). This SE Asian species has been taken widely across northern Australia, on a range of plants but only in low numbers. *T. taiwanus* Takahashi, recorded from Australia by Mound and Gillespie (1997), is now recognised as a synonym of *T. parvispinus* (Mound and Collins 2000). The species is considered to have the potential to become a serious pest. It was recently recorded in Europe for the first time.

*Thrips seticollis* (Bagnall). Known previously only from the holotype female collected near Perth (WA), this is the only member of the genus to have a pre-apical claw on the fore tarsus. Single females have been collected on three occasions recently in the ACT and another female in Tasmania, all of which share with the holotype this as well as other character states. The host plant is probably a member of the Epacridaceae, but this has yet to be confirmed.

*Thrips setipennis* (Bagnall). This is one of the most common flower thrips along the eastern coast of Australia. It breeds in the flowers of a wide range of unrelated plants, including *Lomandra* (Xanthorrhoeaceae), *Prostanthera* (Lamiaceae) and *Notelaea* (Oleaceae). Williams, Adam and Mound (2001) indicated that this thrips is the specific pollinator of the small tree *Wilkiea huegeliana* (Monimiaceae) and possibly of other trees in the eastern rainforests.

#*Thrips trehernei* Priesner. This European species is probably widespread in southeastern Australia, having been taken in the flowers of *Taraxacum officinale* (Asteraceae) at several sites in NSW, ACT and SA (Mound 1998).

*Trichromothrips bilongilineatus* (Girault). This species was placed in *Trichromothrips* by Mound & Houston (1987) and *Dorcadothrips* Priesner was synonymised subsequently with this by Bhatti (1999). This genus now includes 27 species, mainly from the Old World tropics, but with very little information on biology. Adult females of *T. bilongilineatus* have been taken several times from ferns at Gosford (NSW), although there is no evidence that the species breeds on these plants.

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# NOTES ON ANT-LYCAENID ASSOCIATIONS (HYMENOPTERA: FORMICIDAE AND LEPIDOPTERA: LYCAENIDAE) IN SOUTHEAST QUEENSLAND

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## Abstract

Thirty-one new ant associations are reported for immature stages of facultatively myrmecophilous lycaenid butterflies from southeast Queensland. Larvae of three species, *Rapala varuna* (Horsfield), *Erysichton lineata* (Murray) and *Psychonotis caelius* (C. Felder), are reported in weak associations with ants for the first time. The introduced ant *Technomyrmex ?albipes* (Smith) is identified as the most common attending ant of facultative lycaenids in disturbed habitats around Brisbane.

## Introduction

An interesting feature of lycaenid biology is the mutualistic associations between their immature stages and ants (Pierce *et al.* 1987). These associations vary in intensity and in the degree of specificity between partners (Fiedler 1991, Eastwood and Fraser 1999). Larvae of many lycaenid species possess specialised glands which attract, reward and appease attendant ants that may otherwise be aggressive towards them (Malicky 1970). In return ants may protect lycaenid larvae against predators and parasitoids (Pierce *et al.* 1987).

A recent review of lycaenid-ant associations in Australia by Eastwood and Fraser (1999) provided a classification for the level of ant attendance typical for mature larvae of each species. Facultatively ant-associated lycaenids are attended by a broad range of (usually) ecologically subordinate ants, while obligately ant-associated species are attended by a restricted range of (usually) ecologically dominant ants.

This paper reports on a collection of ants found attending lycaenid immature stages in southeast Queensland. Results are discussed in light of Eastwood and Fraser's (1999) review.

A voucher collection of ants is lodged in the Queensland Museum. Butterfly nomenclature follows Braby (2000), spelling of lycaenid names follows Common and Waterhouse (1981). Ant nomenclature follows Shattuck (1999) and R. Kohout (pers. comm.) for *Polyrhachis* spp.

## Results

Details of all lycaenid-ant associations recorded in this survey are presented in Table 1. New records involving lycaenids with no previously recorded ant associations and new records of poorly documented associations are discussed below. Other new records and confirmation of previously recorded associations appear in Table 1 only.

**Table 1.** Ant attendance records for lycaenid butterfly larvae and pupae in southeast Queensland. DM= Degree of Myrmecophily (from Eastwood and Fraser 1999): 0, no interaction; 1, weakly myrmecophilous; 2, moderately myrmecophilous; 3, steadily myrmecophilous; 4, obligately myrmecophilous. Numbers in parentheses indicate modified degree of myrmecophily from present study. AL= Attendance Level (after Eastwood and Fraser 1999): N, not attended; L, light attendance <5 ants; H, heavy attendance >5 ants. Ant subfamilies are indicated at first mention of taxon.

| Lycaenid taxon | DM | AL | Attending ant<br>*: new record<br>L: ants attending larva<br>P: ants attending pupa | Location (Date) |
|---|---|---|---|---|
| *Hypochrysops cyane* (Waterhouse & Lyell) | 4 | H | *Anonychomyrma* sp.$^{LP}$ (Dolichoderinae) | Inala (15.viii.1999) |
| | | H | *Anonychomyrma* sp.$^{LP}$ | Indooroopilly (i.2000) |
| *H. epicurus* Miskin | 4 | H | *Anonychomyrma* sp.$^{LP}$ | Redland Bay (5.ii.2000) |
| *H. ignitus ignitus* (Leach) | 4 | H | *Papyrius* sp.$^{LP}$ (Dolichoderinae) | Peregian Beach (12.xii.1999) |
| *H. digglesii* (Hewitson) | 4 | H | *Crematogaster* sp.$^{LP}$ (Myrmicinae) | nr Mt Elliot, Boonah (2.vi.1999) |
| *H. apelles* (Fabricius) | 4 | H | *Crematogaster* sp.$^{LP}$ | Redland Bay (5.ii.2000) |
| *H. byzos* (Boisduval) | 1 | N | Not Attended | Girraween (31.i.2001) |
| *Philiris innotata* (Miskin) | 1 | L | *Technomyrmex ?albipes* *$^{L}$ (Dolichoderinae) | Landsborough (11.ii.2001) |
| | | N | Not attended | Oxley Ck, Moggill Ck, Landsborough |
| *Ogyris genoveva* (Hewitson) | 4 | H | *Camponotus* sp.$^{L}$ (Formicinae) | Leslie Dam, Warwick (18.iii.2000) |
| | | H | *Camponotus* sp.$^{L}$ | Leyburn (31.i.2001) |
| *O. zosine* (Hewitson) | 4 | H | *Camponotus* sp.$^{LP}$ | nr Mt Elliot, Boonah (2.vi.1999) |
| | | H | *Camponotus* sp.$^{L}$ | nr Mt Elliot, Boonah (27.vi.1999) |
| | | H | *Camponotus* sp.$^{LP}$ | nr Mt Elliot, Boonah (21.v.2000) |
| *O. abrota* (Westwood) | 3 | L | *Crematogaster* sp.$^{LP}$ | Crows Nest (i.2000) |
| | | N | Not Attended | Girraween (31.i.2001) |
| *O. amaryllis amaryllis* (Hewitson) | 4 (3) | L | *Crematogaster* sp.$^{LP}$ | Wacol (30.i.1999) |
| | | L | *Crematogaster* sp.$^{L}$ | Beenleigh (26.xi.2000) |
| | | L | *Crematogaster* sp.$^{L}$ | Redland Bay (3.xii.2000) |
| | | L | *T. ?albipes* *$^{LP}$ | Redland Bay (17.ix. & 3.xii.2000) |

| | | | | |
|---|---|---|---|---|
| *O. amaryllis amaryllis* (cont.) | | L | *Paratrechina* sp.*[L] (Formicinae) | Pullen Pullen Ck (23.vii.2000) |
| | | N | Not attended | Wacol, Moggill Ck, Oxley Ck, Pullen Pullen Ck |
| *O. oroetes oroetes* (Hewitson) | 3 | L | *Rhytidoponera* sp.*[L] (Ponerinae) | Ebbw Vale (7.ii.1999) |
| | | L | *Ochetellus* sp.[L] (Dolichoderinae) | Gailes (7.ii.1999) |
| | | L | *Ochetellus* sp.[P] | Kookaburra Park, Salisbury (13.ii.1999) |
| | | L | *T. ?albipes* *[L] | Salisbury Park, Salisbury (6.ii.1999) |
| | | L | *Meranoplus* sp.[L] (Myrmicinae) | Leslie Dam, Warwick (18.iii.2000) |
| | | L | *Crematogaster* sp.[P] | Eight Mile Plains (6.ii. & 22.viii.1999) |
| | | L | *Crematogaster* sp.[P] | Corinda |
| | | L | *Iridomyrmex* sp.[P] (Dolichoderinae) | Kookaburra Park, Salisbury (6.ii.1999) |
| | | N | Not attended | All above locations |
| *O. olane* (Hewitson) | 3 | L | *Crematogaster* sp.[P] | Eight Mile Plains (22.viii.1999) |
| | | L | *Crematogaster* sp.[L] | Leslie Dam, Warwick, not collected (18.iii.2000) |
| | | L | *?Iridomyrmex* sp.[P] | Kookaburra Park, Salisbury (22.viii.1999) |
| | | N | Not attended | Browns Plains, Salisbury, Indooroopilly, Gailes, Leyburn |
| *O. barnardi barnardi* (Miskin) | 3 | L | *Crematogaster* sp.[P] | Leyburn (3.x.1999) |
| | | N | Not attended | Leyburn |
| *Jalmenus evagoras evagoras* (Donovan) | 4 | H | *Iridomyrmex* sp.[LP] | Toohey Forest (x.2000) |
| | | H | *Iridomyrmex* sp.[LP] | Toowoomba (5.iv.1999) |
| | | H | *Iridomyrmex* sp.[LP] | Mt Coot-tha |
| *Deudorix diovis* Hewitson | 1 | L,H | *Pheidole megacephala* *[LP] (Myrmicinae) | South Brisbane (20.ix.1999; 19.x. & 25.xi.2000) |
| | | L,H | *T. ?albipes* *[L] | South Brisbane (12. xi.1998; 19.x.1999) |
| | | L | *T. ?albipes* [LP] | Oxley Ck, Corinda (9.i.2000) |

| | | | | |
|---|---|---|---|---|
| *Deudorix diovis* (cont.) | | L | *T. ?albipes* [P] | Wishart (11.viii.1999) |
| | | L | *T. ?albipes* [L] | Graceville (15.x.2000) |
| | | L | *Iridomyrmex* sp.*[L] | South Brisbane (11.xi.1999; 19.vii.2000) |
| | | L | *Iridomyrmex* sp.[L] | Corinda (29.x.2000) |
| | | L | *Iridomyrmex* sp.[P] | Oxley (27.viii.2000) |
| | | L | *Iridomyrmex* sp.[L] | Wishart (15.x.2000) |
| | | L | *Tetramorium* sp.*[LP] (Myrmicinae) | Sherwood (14.xi.1999) |
| | | L | *Polyrhachis* (*Chariomyrma*) *aurea* Mayr *[L] (Formicinae) | Archerfield (19.xi.2000) |
| | | L | *Polyrhachis* (*Cyrtomyrma*) *australis* Mayr *[L] | South Brisbane (i.2000) |
| | | L | *Polyrhachis* sp.[L] | Sherwood, specimen lost (15.v.2000) |
| | | L | *Polyrhachis* (*Hagiomyrma*) *lydiae* Forel *[L] | Archerfield (19.xi.2000) |
| | | L | *Paratrechina* sp.*[P] | Archerfield (v.2000) |
| | | N | Not attended | All above locations |
| *Rapala varuna* (Horsfield) | 0 (1) | L | *T. ?albipes* *[L] | Oxley Ck, Corinda (xii.1999) |
| | | L | *T. ?albipes* [L] | Sherwood (25.iv.2001) |
| | | N | Not attended | Oxley Ck, Toohey Forest, Sherwood, |
| *Candalides margarita* (Semper) | 1 | N | Not attended | Moggill Ck, Sherwood, Rocklea |
| *C. absimilis* (C. Felder) | 1 | L | *Polyrhachis* (*Cyrtomyrma*) *australis* *[L] | Sherwood (19.i.2000) |
| | | L | *T. ?albipes* *[L] | Herston (1.iv.2000) |
| | | L | *Iridomyrmex* sp.*[L] | Sherwood (29.x.2000) |
| | | N | Not attended | Springwood, Sherwood |
| *Nacaduba berenice* (Herrich-Schäffer) | 2 | L | *Paratrechina* sp.[L] | South Brisbane (1.ix.1999) |
| | | L | *Pheidole megacephala* *[L] | Brisbane CBD (17.iii.2000) |
| | | L | *Crematogaster* sp.[L] | Mt Coot-tha (18.ii.2001) |
| | | H | *T. ?albipes* *[L] | Sherwood (9.iv.2000) |
| | | L,H | *T. ?albipes* *[L] | Brisbane CBD (14.ii.2001) |
| | | L | *Polyrhachis* (*Cyrtomyrma*) *australis* *[L] | South Brisbane (iii.2000; 12.ii.2001) |

| | | | | |
|---|---|---|---|---|
| *Nacaduba berenice* (cont.) | | L | *Polyrhachis* sp.[L] | Coopers Plains (viii.2000) |
| | | L | *Tapinoma* sp.*[L] (Dolichoderinae) | South Brisbane (12.ii.2001) |
| | | N | Not attended | Sherwood, South Brisbane |
| *N. biocellata* (C. Felder & R. Felder) | 2 | L | *T. ?albipes* *[L] | Oxley Ck, Corinda (28.ix.2000) |
| | | N | Not attended | Sherwood, Rocklea, Toohey Forest, Mt Coot-tha |
| *Erysichton lineata* (Murray) | 0 (1) | L | *Polyrhachis* (*Cyrtomyrma*) *pilosa* Donisthorpe *[L] | Sherwood (21.iv.2000) |
| | | N | Not attended | Sherwood, Wishart, Mt Coot-tha, Mt Glorious |
| *Psychonotis caelius* (C. Felder) | 0 (1) | L | *T. ?albipes* *[L] | Oxley Ck, Corinda (xii.1999) |
| | | N | Not attended | Oxley Ck, Toohey Forest, Springwood |
| *Prosotas felderi* (Murray) | 0 (1) | L | *Crematogaster* sp.[L] | Rocklea (14.v.2000) |
| | | L | *Dolichoderus* sp.*[L] (Dolichoderinae) | nr Mt Elliot, Boonah (21.v.2000) |
| | | N | Not attended | Sherwood, Rocklea, Toohey Forest, Springwood, Mt Coot-tha |
| *P. dubiosa* (Semper) | 0 | N | Not attended | Sherwood, Mt Coot-tha |
| *Catopyrops florinda* (Butler) | 2 | L,H | *T. ?albipes* *[L] | Herston (1.iv.2000) |
| | | L | *Polyrhachis* (*Cyrtomyrma*) *australis* *[L] | Benwarra Park, Oxley Ck |
| | | N | Not attended | Rocklea, Sherwood, Brisbane CBD |
| *Sahulana scintillata* (T.P. Lucas) | 0 | N | Not attended | Rocklea, Toohey Forest, Mt Coot-tha |
| *Leptotes plinius* (Fabricius) | 2 | L | *Iridomyrmex* sp.*[L] | Sherwood (26.ii. & 8.x.2000) |
| | | L | *Paratrechina* sp.*[L] | Sherwood (29.xii.2000) |
| | | N | Not attended | Sherwood, Brisbane CBD, Springwood |
| *Lampides boeticus* (Linnaeus) | 3 | N | Not attended | Corinda, South Brisbane |
| *Zizina labradus* (Godart) | 3 | L | *Iridomyrmex* sp.*[L] | South Brisbane (21 & 28.ix.2000) |
| | | L | *Prolasius* sp.*[L] (Formicinae) | South Brisbane (28.ix.2000) |
| | | N | Not attended | South Brisbane |

## New records

*Philiris innotata* (Miskin)

Larvae were not attended by ants at several sites in Brisbane and at Landsborough (Table 1). On one tree at Landsborough 6 out of 20 larvae were each attended by a single *Technomyrmex ?albipes* (Dolichoderinae) worker at the time of collection. The ants antennated over the entire larval dorsal surface but concentrated their efforts at the dorsal nectary organ (DNO) on the seventh abdominal segment. Ant attendance of this species has been recorded on only a few occasions from northern Queensland (Eastwood and Fraser 1999). This record is the first from the southern part of its range.

*Rapala varuna* (Horsfield)

A single *T. ?albipes* worker was found attending a larva feeding on *Alphitonia excelsa* at Oxley Ck, Brisbane. This ant rapidly antennated the DNO, but paid no attention to other regions of the larva. Other larvae were ignored by *T. ?albipes* and by several other ants (*viz. Polyrhachis* sp., *Iridomyrmex* sp.), which were foraging for nectar on the flowers within centimeters of many *R. varuna* larvae. A single mature larva found feeding on flowers of *Eriobotrya japonica* at Sherwood, Brisbane, was continuously attended by five *T. ?albipes* ants. The ants removed droplets of clear fluid from the larval DNO and on several occasions the larval tentacular organs (TO's) were fully everted. Ant attendance has not been reported previously for *R. varuna* larvae (Eastwood and Fraser 1999).

*Erysichton lineata* (Murray)

A single ant, *Polyrhachis* (*Cyrtomyrma*) *pilosa* Donisthorpe (Formicinae), was found straddled over a mature larva located on a flower of *Macadamia integrifolia* at Sherwood, Brisbane. The ant and larva remained in contact after several days in captivity, during which time the ant was observed to antennate and remove fluid from the DNO on numerous occasions. The larva also everted its TOs in the presence of the ant. Ant attendance of *E. lineata* has not been reported previously (Eastwood and Fraser 1999) and is a rare occurrence in Brisbane, where numerous unattended larvae were observed (Table 1).

*Psychonotis caelius* (C. Felder)

Two larvae feeding on flowers of *Alphitonia excelsa* at Oxley Ck, Brisbane were each attended by single *T. ?albipes* workers. The ants alternated between antennating the larval DNO for brief periods (never for more than about five seconds) and foraging on flowers. The larva in each case did not respond in any noticeable way to the ants. Larval TO's were not seen in a fully extended state. Ant attendance has not been reported previously for this species (Eastwood and Fraser 1999) and the great majority of larvae found in Brisbane were unattended.

*Prosotas felderi* (Murray)

Five larvae on a single food plant, *Acacia disparrima* subsp. *disparrima* at Rocklea, Brisbane were each attended by a single *Crematogaster* sp. (Myrmicinae) worker. All larvae on nearby trees were unattended. Near Mt. Elliot at Boonah, a single larva was found with a large *Dolichoderus* sp. (Dolichoderinae) worker in attendance. In captivity the ant remained with the larva until it pupated several days later. All ant tended larvae responded to attention by the ants with intermittent extension of the TO's and production of fluid droplets from the DNO which the ants removed. Ant attendance of *P. felderi* is uncommon with only one prior report (Braby 2000).

**Discussion**

Lycaenid-ant associations reported here are in accordance with the patterns described by Eastwood and Fraser (1999). Facultative species such as *Deudorix diovis* Hewitson, *Ogyris oroetes* (Hewitson) and *Nacaduba berenice* (Herrich-Schäffer) are able to appease a variety of ant genera from several subfamilies. The 31 new facultative ant-lycaenid associations reported in Table 1 are therefore unsurprising. Ant genera commonly found in facultative association with lycaenid larvae in this survey include *Technomyrmex* (associated with 10 species), *Crematogaster* (7 species), *Iridomyrmex* (6 species), *Polyrhachis* (5 species) and *Paratrechina* (4 species). These genera commonly associate with facultative myrmecophilous lycaenids (see Eastwood and Fraser 1999).

The high incidence of association with *Technomyrmex* is unusual and possibly reflects the abundance of *T.* ?*albipes* in Brisbane. *Technomyrmex albipes* is native to Japan and is now a nuisance pest in many tropical countries owing to its habit of forming large colonies (estimated to sometimes exceed 1 million individuals) in residential areas (Weissling *et al.* 1998). It is a common ant in disturbed habitats such as suburban parks, gardens and remnant bushland in Brisbane (D. Schmidt pers. obs.). At sites such as Oxley Ck, Corinda the high local abundance of *T.* ?*albipes* appears to be achieved by its large colony size and interconnected colony structure. Nests often occurred under flaking bark of trees and individuals foraged at high densities over virtually all vegetation in the area. In these situations lycaenid larvae and homopterans often are attended and even normally unattended species such as *Psychonotis caelius* receive some attention. The ecological impact of *T. albipes* in Australia is unknown.

Larvae of *R. varuna*, *E. lineata*, *P. caelius* and *P. felderi* possess typical lycaenid myrmecophilous organs including a dorsal nectary organ and tentacular organs. Each of these species was found to be weakly myrmecophilous, their larval stages rarely being found with attendant ants and therefore all would be classified as level 1 in the schema of Eastwood and Fraser (1999).

Larvae of lycaenids classified as obligately ant associated by Eastwood and Fraser (1999) (*e.g. Hypochrysops* spp.), were in most cases found with their characteristic ant genera in attendance (Table 1). One exception was *Ogyris amaryllis amaryllis* (Hewitson), which was found with several different genera and subfamilies of ants in attendance (Table 1). Eastwood and Fraser (1999) recognised this species as an anomaly in their review and additional records here confirm that further work is required to understand the ant associations exhibited by this taxon over its vast range (Schmidt and Rice, in press). Due to the low attendance levels observed during this study and the range of ants found in attendance, the subspecies *O. a. amaryllis* is tentatively treated here as facultatively myrmecophilous in southeast Queensland.

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# PARASITISATION RATES OF SOME PARASITOIDS (HYMENOPTERA: ICHNEUMONIDAE) OF THE AUTUMN GUM MOTH (LEPIDOPTERA: GEOMETRIDAE)

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## Abstract

Information is provided on one tachinid (Diptera) and four ichneumonid (Hymenoptera) parasitoids of the autumn gum moth *Mnesampela privata* (Guenée) (Geometridae). Parasitisation rates are given for the unidentified tachinid and the ichneumonid *Heteropelma scaposum* (Morley) (Anomaloninae). A combined parasitisation rate is given for an unidentified species of *Pristiceros* Gravenhorst plus an undescribed species of *Neolevansa* Gauld (both Ichneumoninae: Platylabini). This is the first host record for any *Neolevansa* species. Also reported as a parasitoid is an unidentified species of *Eriborus* Förster (Campopleginae). An earlier report of an ichneumonid from the genus *Anacis* Porter (Cryptinae: Cryptini) as a parasitoid of *M. privata* is corrected.

## Introduction

The autumn gum moth *Mnesampela privata* (Guenée) (Geometridae: Ennominae) is a serious pest of *Eucalyptus globulus* and *E. nitens* plantations in southeastern and southwestern Australia (Neumann and Collett 1997, Elliott *et al.* 1998). While studying the seasonal phenology of this moth, Lukacs (1999) collected data on its natural enemies, which we report in this paper.

## Materials and methods

Approximately 2,000 fifth (final) instar larvae of *M. privata* were collected from various sites in Tasmania and Victoria (see Lukacs 1999 for site details). One hymenopteran morphospecies of larval parasitoid was noticed and three specimens were kept for later identification. The *M. privata* pupae were reared under a number of different environmental regimes until an adult moth emerged, one or more parasitoids emerged or the pupa died. Parasitoids were separated into morphospecies. Emergence data were recorded for each cohort of pupae and each morphospecies of parasitoid. A small number of parasitoids were kept for later identification. All specimens are deposited in the Australian National Insect Collection (ANIC), Canberra.

## Results

### *Identities of the parasitoids*

We identified the larval parasitoid as a species of *Eriborus* Förster (Ichneumonidae: Campopleginae). Lukacs (1999) initially recognised three morphospecies of larval-pupal parasitoids, a tachinid fly which was not identified further and two ichneumonids.

The larger of the ichneumonid morphospecies was identified as *Heteropelma scaposum* (Morley) (Anomaloninae). On closer inspection, the smaller ichneumonid morphospecies actually comprised two species, both belonging to the subfamily Ichneumoninae, tribe Platylabini. One was a species of *Pristiceros* Gravenhorst while the other was an undescribed species of *Neolevansa* Gauld. Since we possess only one specimen of our species of *Neolevansa*, we have refrained from formally describing it as new. However, Table 1 (see also Figs 1-4) gives diagnostic features to distinguish this species, *Neolevansa* sp. 1, from the only described species of the genus, *N. hirsuta* Gauld. Note that according to Gauld (1984), there are 11 undescribed species of *Neolevansa* known, all from Australia.

**Table 1**. Characters for distinguishing *Neolevansa* sp. 1 from *N. hirsuta*.

| Character | *Neolevansa hirsuta* | *Neolevansa* sp. 1 |
|---|---|---|
| Area superomedia | A little longer than wide (Fig. 1) | Distinctly wider than long (Fig. 2) |
| Texture between punctures on metapleuron | Smooth and shining | Somewhat rugose |
| Predominant colour of head and mesosoma | Black (Figs 1, 3) | Reddish-brown (Figs 2, 4) |
| Pale yellow band along medioposterior margin of pronotum | Present | Absent |
| Number of pale yellow spots on lower mesopleuron | Two (Fig. 3) | One (Fig. 4) |

*Oviposition behaviour in the field*

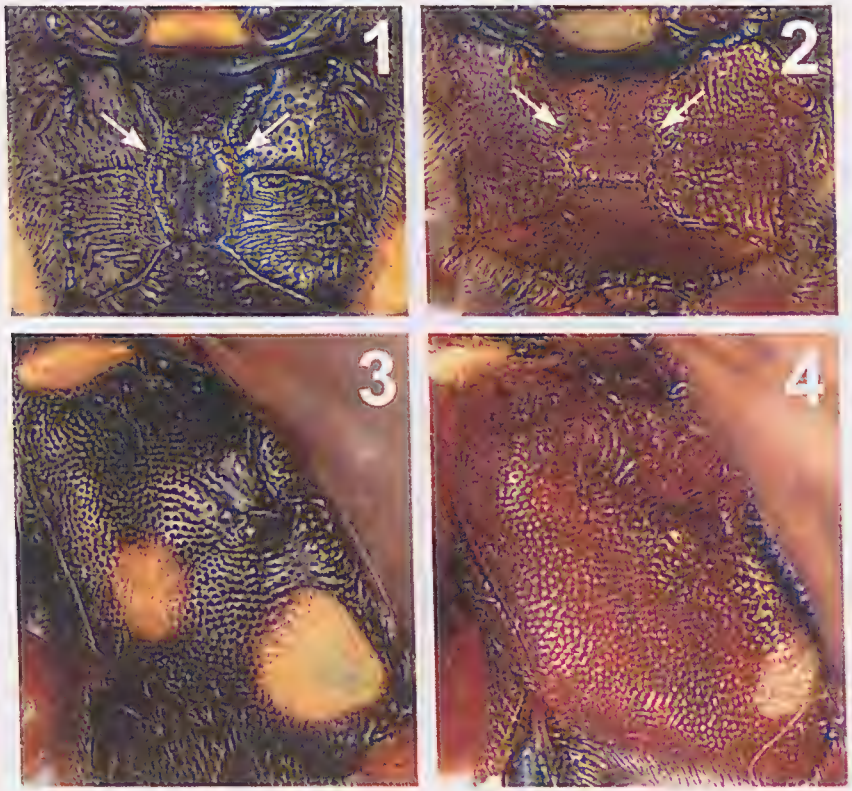
*Heteropelma scaposum* was observed ovipositing in first instar larvae but not in later instars. *Neolevansa* sp. 1 or *Pristiceros* sp. (identity uncertain) was usually seen walking over foliage and crawling into larval shelters in search of older larvae. It readily oviposited in fifth instar larvae it found exposed on the leaf surface inside thin silk shelters. Neither the *Eriborus* sp. nor the tachinid fly were observed in the field.

*Parasitisation levels*

A total of 1,211 *M. privata* pupae were formed in the laboratory. The parasitisation rates for cohorts of pupae ranged from 0.0% to 35.7%, with an overall rate of 9.1% (Table 2). Generally, the parasitoids emerged in synchrony with the moths, indicating that the development of both is tightly linked. Records were not kept for the larval parasitoid *Eriborus* sp.

**Table 2.** Parasitisation rates of three morphospecies of larval-pupal parasitoids.

| Morphospecies | Average parasitisation rate | Range across cohorts |
|---|---|---|
| *Neolevansa* sp. 1 / *Pristiceros* sp. | 4.6% | 0.0-35.7% |
| *Heteropelma scaposum* | 3.6% | 0.0-16.7% |
| Tachinid fly | 0.8% | 0.0-8.3% |
| **Overall** | **9.1%** | **0.0-35.7%** |




**Figs 1-4.** Propodeum and mesopleuron of *Neolevansa* spp. (1) *N. hirsuta*, propodeum; (2) *N.* sp. 1, propodeum; (3) *N. hirsuta*, mesopleuron; (4) *N.* sp. 1, mesopleuron.

## Discussion

*Mnesampela privata* constitutes the first host record for any species of *Neolevansa*. This association is not surprising given that almost all known hosts of Platylabini are geometrid moths (Gauld 1984). All of the other taxa, namely Tachinidae, *Eriborus*, *Pristiceros* and *Heteropelma scaposum*, have already been recorded as parasitoids of *M. privata* (Elliott and Bashford 1978, de Little 1981, Gauld 1984, Schumacher *et al.* 2000). Their parasitisation rates, though, have not previously been measured.

One of the preliminary identifications in Lukacs (1999) is incorrect. The morphospecies identified here as *Neolevansa* sp. 1/*Pristiceros* sp. was called *Anacis* sp. by Lukacs (1999). This error (albeit as ?*Anacis* sp.) was repeated by Schumacher *et al.* (2000), where on one occasion it was misspelt *Anacris* sp. This morphospecies was originally called *Anacis* sp. because of a suggestion by Ian Naumann (ANIC, Canberra), who did not examine specimens but merely commented on a photograph (Lukacs 1999, p. 238).

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# *EUPLOEA* BUTTERFLIES OF THE REMOTE SANTA CRUZ ISLANDS (TEMOTU PROVINCE, SOLOMON ISLANDS): NAMES, PHENOTYPES AND DISTRIBUTION (LEPIDOPTERA: NYMPHALIDAE: DANAINAE)

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## Abstract

Based on recently collected material from the Santa Cruz Islands (Temotu Province, Solomon Islands), distribution of subspecies of *Euploea sylvester* Fabricius, *E. leucostictos* Gmelin, *E. boisduvalii* Lucas, *E. treitschkei* Boisduval and *E. lewinii* Felder & Felder in the islands is discussed. The names *era* de Nicéville, 1902 and *matemae* Carpenter, 1953 are newly synonymised with *E. boisduvalii lapeyrousei* Boisduval, 1832. The name *brunnescens* Carpenter, 1953 is newly synonymised with *E. lewinii lilybaea* Fruhstorfer, 1911.

## Introduction

The danaine genus *Euploea* Fabricius is very diverse in the large islands of the Solomon archipelago in the tropical southwest Pacific. Some islands (*e.g.* San Cristobal, Malaita, Rennell) support remarkable mimetic butterfly assemblages, involving *Euploea*, *Danaus* Kluk (Danainae) and *Hypolimnas* Hübner (Nymphalinae), with quite different phenotypes of the same species occurring on adjacent islands. Fewer taxa have penetrated as far as the smaller islands of Micronesia and Polynesia further east. Mimetic associations and distribution of Pacific danaines were examined by Poulton (1924, 1926), Carpenter (1942, 1953), Ackery and Vane-Wright (1984) and Dudley and Adler (1996).

This paper deals with the nomenclature and distribution of *Euploea* species and subspecies in the remote Santa Cruz group of islands, politically part of the Solomon Islands, but geographically closer to the New Hebrides archipelago (Vanuatu), in preparation for a forthcoming book on the butterflies of the Solomon Islands. It also deals with the nomenclature of the islands themselves (Fig. 1). In a comprehensive taxonomic and biogeographical study, Carpenter (1953) was concerned largely with the distribution of *Euploea* forms and subspecies in the Pacific. Recently collected material has enabled resolution of some apparent anomalies.

The main island of the Santa Cruz group appears in the Times Atlas of the World as 'Ndeni' and this has often been used in the literature, including by the present author (Tennent 1999, 2000, 2001). The name is not recognised by local people, who call the island 'Santa Cruz' or 'Nendo'. The small islands of Trevanion and Lord Howe lie a few hundred metres off the northwest and southeast coasts of Nendo respectively. To the north of Nendo lies the active volcano of Tinakula and northeast of Tinakula are the scattered islands of the Reef and Duff groups. Utupua and Vanikoro lie southeast of

Nendo and the latter is only some 160 km north of the most northerly islands of the Torres group (Vanuatu). An alternative name for the Reefs is 'Swallow' or 'the Swallows', which also appears in the Times Atlas and has been used by authors including Carpenter (1953) and Ackery and Vane-Wright (1984). Like Ndeni, the name is not recognised locally. The Reef group includes the small western outliers of Matema and Pileni and should not be confused with the Reef Islands which form part of the Banks island group of northern Vanuatu, some 400 kilometres to the southeast. Still further east lie the tiny and remote Polynesian islands of Tikopia, Anuta and Fatutaka. Anuta and Fatutaka are referred to as 'Cherry' and 'Mitre' by the Times Atlas. There are no butterfly records from uninhabited Fatutaka.

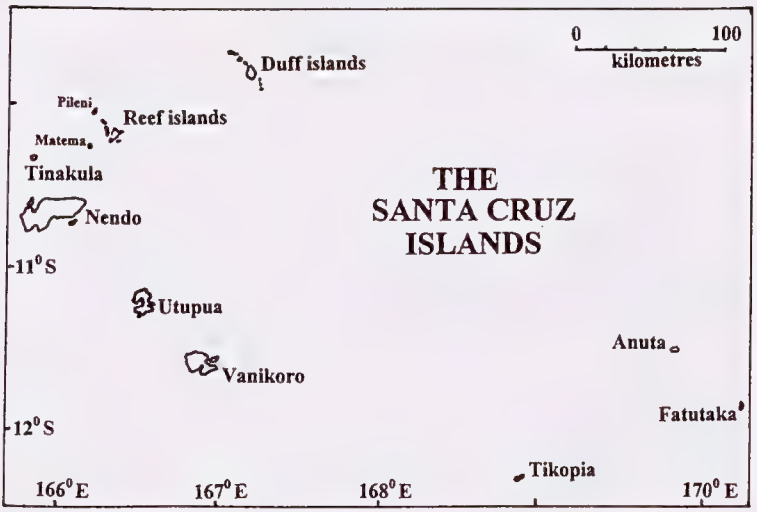


**Fig. 1.** Map of the Santa Cruz Islands.

A previous lack of material (Carpenter 1953) has in some cases hampered assignation of *Euploea* populations to subspecies. The author spent several months in the Santa Cruz group in 2000 and made collections of *Euploea* butterflies on all islands visited. Collections were also made on some northern islands of Vanuatu, including the Torres group, from where few specimens have also previously been available. This combined material has made it possible to reassess distribution of some Santa Cruz phenotypes. Collection of *Euploea* (and *Danaus affinis* Fabricius) specimens is considerably assisted throughout the tropical Pacific by the attraction of males (and occasionally females) to the withered leaves and twigs of plants, including *Argusia argentea* (Boraginaceae), from which they sequester chemical compounds for use in defence against predators.

Several hundred specimens have been deposited in The Natural History Museum (BMNH), London. The following abbreviation has been used: TL - Type locality.

**The Santa Cruz group *Euploea* species**

***Euploea sylvester* Fabricius, 1793** (TL: [Australia])

In a consolidated list (Carpenter 1953) of Pacific *Euploea* distribution, *melander* Grose-Smith, 1897 (TL: 'Santa Cruz') and *tristis* Butler, 1866 (TL: Vanuatu) were regarded as geographical subspecies, whilst *moesta* Butler, 1866 (TL: Irian Jaya) was noted as a 'form'. Carpenter (1953) said of *moesta* 'under this name are included the poorly spotted forms ...' and went on to separate *melander*, *tristis* and other forms, including *moesta*, on the basis of geographical distribution, in effect applying all of these names at the level of subspecies. Carpenter reported two male *moesta* from Matema, several *melander* from Santa Cruz [Nendo], Utupua, Vanikoro and the Reefs (Banks group) and *tristis* from many islands of Vanuatu, including the Banks and Torres groups. He reported a solitary male *tristis* from Matema, which he regarded as an 'unusual locality' for this subspecies. Samson (1979) regarded Santa Cruz *sylvester* as *melina* Godart, 1819 (TL: Moluccas).

Carpenter (1953) said 'It might seem legitimate to claim that as *tristis* ... *moesta* [and] *melander* ... seem closely connected by intermediates it would be justifiable to treat all as synonyms of *tristis*. Yet the geographical distribution supports continuance of these names'. Collection of further material confirms an apparent line of demarcation between the Santa Cruz group and, for example, the Torres group. In a series of 37 males and 5 females collected by the present author from Nendo, the Reefs (Ngadeli, Nifololi, Lomlom, Pileni), Utupua and Vanikoro, only 6 males (Nendo, Reefs [Ngadeli, Lomlom]) have prominent white submarginal spots on the upperside of the hindwing and white subapical markings on the upperside of the forewing, whilst the remainder have an unmarked hindwing (or almost so) and blue subapical spots on the forewing. By comparison, males from a series of 6 males and 14 females from the Torres group have prominent white subapical and submarginal markings. Females are more variable and may be difficult to separate.

In the opinion of the present author, populations of all Santa Cruz Islands from which material is available are referable to *E. s. melander*, whilst populations from the Torres group to the south are *E. s. tristis*. The species has not been reported from Tikopia, Anuta or the Duff group.

***Euploea leucostictos* Gmelin, 1790** (TL: [Ambon])

*E. leucostictos crucis* Carpenter, 1953 was described from three males and one female from Santa Cruz [Nendo] and a 'small' male specimen of *polymela* Godman & Salvin, 1888 (TL: Solomon archipelago [syntypic series]), the usual form from the Solomon archipelago further west, was also

noted from Santa Cruz. Carpenter (1953) said of this specimen 'The specimen from Santa Cruz ... is of particular interest, seeing that another form of [*leucostictos*] occurs there: possibly this one was an intruder'. Carpenter went on to describe *eustachiella* Carpenter, 1953 from a male and two females from Anuta and to report (Carpenter 1953) five male *iphianassa* Butler, 1866 (TL: Vanuatu: Aneityum) and a male *novarumebudum* Carpenter, 1942 (TL: Vanuatu: Espiritu Santo) from Tikopia among long series of both subspecies from the islands of Vanuatu.

Examination of a long series of *E. leucostictos* from Nendo, the Reefs (Matama, Ngadeli, Lomlom, Pileni, Temotuana'a Atoll), the Duffs, Utupua and Vanikoro, suggests that *E. l. crucis* is a variable insect. Many males lack subapical markings, whilst others have a curved series of white subapical spots. Females are more variable, but few have the prominent hindwing submarginal spots characteristic of *E. l. iphianassa*. By comparison, a series of 23 males and 8 females from Tikopia are significantly less variable. Males are large and dark in appearance and both sexes are indistinguishable from *E. l. iphianassa* from the Torres group. Thus, it is clear that *E. l. crucis* occurs on all western islands of the Santa Cruz group, whilst *E. l. iphianassa* occurs on Tikopia, as well as on the Torres group in northern Vanuatu. The author was unfortunately only able to spend one day on Anuta, in dull weather. *E. leucostictos* was not seen and no comment is made regarding the status of *E. l. eustachiella*, beyond noting that Carpenter (1953) agreed that some specimens of *eustachiella*, *eustachius* Kirby, 1899 (New Guinea) and *iphianassa*, differed little.

***Euploea boisduvalii* Lucas, 1853** (TL: 'Australia' [?Fiji])

In addition to *era* de Nicéville, 1902 (TL: 'Santa Cruz' [?Nendo]) from Nendo and Reef Island (Banks group), Carpenter (1953) reported *lapeyrousei* Boisduval, 1832 (TL: Vanikoro) from Vanikoro and Utupua, and *matemae* Carpenter, 1953 (TL: Matema) from Matema and Anuta. It is noted that *bakeri* Poulton, 1927 (TL: Vanuatu: Espiritu Santo) was reported from the Banks group, in addition to seven males from the Reefs. *E. b. era* was reported from Tikopia by Ackery and Vane-Wright (1984).

Carpenter (1953) compared *era* with *torvina* Butler, 1875 (TL: Vanuatu: Aneityum) from the southern islands of Vanuatu. He considered phenotypic differences between *era*, *lapeyrousei* and *matemae* warranted separation at subspecies rank and figured both sexes of each of the last two taxa. Differences between these monochrome illustrations are certainly apparent, with *matemae* displaying much paler wing margins (especially the female) than *lapeyrousei*.

The author collected a series of 47 male and 39 female *E. boisduvalii* from Nendo, Tinakula, the Reefs (Matama, Ngadeli, Nifiloli, Lomlom, Pigeon), the Duffs (from where *boisduvalii* was previously unreported), Utupua, Vanikoro

and Tikopia. This material included 2 males and 1 female from Matema (TL of *matemae*) and 5 males and 16 females from Vanikoro (TL of *lapeyrousei*). It is not possible to separate specimens from any of these localities and in the opinion of the author, populations from all islands of the Santa Cruz group are the same. The question of which name should properly be applied was, in effect, determined by Carpenter (1953) who resolved 'a most complicated tangle of mistakes' concerning the type material and type locality of *lapeyrousei*. There seems no doubt that *lapeyrousei* originated from Vanikoro (appropriately, since it was here that Jean-François de Galaup de La Pérouse met an untimely end in 1788) and the names *era* and *matemae* are here placed as new synonyms of *E. b. lapeyrousei*. It is noted that the islands of Matema and Anuta are more than 400 km distant from each other and it is considered highly unlikely that a distinct geographical subspecies (*i.e. matemae*) occurs on these two tiny islands but not on intervening islands.

***Euploea treitschkei* Boisduval, 1832** (TL: New Ireland)

Carpenter (1953) reported three female *viridis* Butler, 1882 (TL: 'Thursday Island, south of New Guinea' [Torres Strait, Queensland]) 'which can only be classed as transitional to *jessica*' from Vanikoro and one male *aenea* Butler, 1872 (TL: 'Solomon Islands') from Utupua but recorded *jessica* Butler, 1869 (TL: 'Fiji' [almost certainly erroneous]) with a wide geographical range from the Bismarck and Solomon archipelagos to New Caledonia and Vanuatu. He did not record *jessica* from the Santa Cruz group. Samson (1979) reported *E. treitschkei aenea* and *E. treitschkei* f. *jessica* from the Santa Cruz group and Ackery and Vane-Wright (1984) recorded Santa Cruz *treitschkei* as '*Euploea treitschkei* ssp.'.

Carpenter (1953) said 'The variable forms grouped under the specific name *treitschkei* have proved to be extremely troublesome to sort out ...'. Collection of material is also rather more 'troublesome' in the case of *E. treitschkei* than its congeners since males seem rarely to be attracted to the leaves and twigs of *Argusia* trees, but prefer (unidentified) climbing vines (presumably with similar chemical properties to those of *Argusia*). Such vines are usually several metres above ground. Individual butterflies were not observed congregating in the manner of other *Euploea* species in the Santa Cruz Islands.

Despite potential confusion in allocating names geographically suggested by Carpenter (1953), material collected by the author (15 males and 4 females) on Nendo, Utupua and Vanikoro, appear referable to the name *jessica*. There is some variation in males; some have the hindwing unmarked, whilst others have one or more postdiscal white marks, never approaching the large and prominent series of *lorenzo* Butler, 1870 (TL: 'Solomon Islands' [?San Cristobal]) from San Cristobal, the easternmost island of the Solomon archipelago and from certain other islands including the Torres group.

In using the names *jessica* and *lorenzo* above, use of the prefix 'form' or 'subspecies' has been avoided. Although authors disagree on the status of these names, many consider them to be merely widespread forms and there is some evidence to support this. However, in the Solomon archipelago (especially on San Cristobal and in the Santa Cruz group) phenotypes appear geographically more or less constant. *E. treitschkei* would benefit from a thorough revision. It is noted that Carpenter (1953) considered *lorenzo* a synonym of *jessica*.

***Euploea lewinii* Felder & Felder, [1865]** (TL: [Tonga])

*E. lewinii brunnescens* Carpenter, 1953 was described from 12 males and a female from Tikopia and one male from Vanikoro. It was said to be similar in appearance to *lilybaea* Fruhstorfer, 1911 (TL: Vanuatu: Tanna). Carpenter (1953) also recorded two males in the California Academy of Sciences Collection, said to be from Anuta, which were 'not like [*brunnescens*] from Tikopia and Vanikoro, but agree better with Fijian *eschscholtzii* [Felder & Felder, [1865] (TL: Fiji)]'.

In his description of *brunnescens* Carpenter (1953) said '... differs from all other forms of *lewinii* by its light brown colour on the upper side ... the underside is even paler, thus differing from *lilybaea* which [it] most resembles ...'. It is curious that *E. lewinii* was not seen by the author during 8 weeks spent on the island of Tikopia, the TL of *E. l. brunnescens*. This is a small island (it is possible to walk around it in little more than half a day at low tide). Conversely, it was the only danaine seen on a whole day spent on the island of Anuta, where a short series of 11 specimens was collected. Comparison of this series from Anuta, paratypes of *brunnescens* in the BMNH and material from various islands of Vanuatu does not support perceived differences. Indeed, some specimens from, for example, Espiritu Santo and Malekula, have paler undersides than those from Tikopia or Anuta. Other minor characteristics provided by Carpenter appear not to be geographically consistent and *brunnescens* is here placed as a new synonym of *E. lewinii lilybaea* to which, in the opinion of the author, Tikopia and Anuta specimens properly belong. Occurrence of *E. lewinii* on Vanikoro requires confirmation.

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